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## **Elasticity of Mantle Composition (Mg,Fe)O at High Pressure and Temperature**

J. Kung, B. Li, and M.T. Vaughan

Beamline(s): X17B1

**Introduction:** The experiments of Mg/Fe partitioning between ferropericlase (Mg,Fe)O and (Mg,Fe,Al)SiO<sub>3</sub> perovskite showed that the Fe content in the MgO phase can be from 10 to 20 mol% at lower mantle conditions. From previous study, the shear mode properties of the mantle composition (Mg<sub>0.83</sub>,Fe<sub>0.17</sub>)O at high pressure has been affected by the existing Fe-content. Kung et al. (2002) has suggested that the shear properties of (Mg,Fe)O would serve as a better tool to discriminate between the composition models at lower mantle. This study was extended the experimental conditions to high pressures and temperatures in order to measure the thermoelastic properties of mantle composition (Mg,Fe)O to shed a better light on the physical state of the lower mantle.

**Methods and Materials:** (Mg,Fe)O polycrystalline specimen was pre-hot pressed at 10 GPa, ~1000 degree C. The travel time, sample length and density of the material are used to determine the elasticity of the material. The travel times were collected using ultrasonic. Ultrasonic measurements at high pressure and temperature were performed using a DIA-type, large-volume apparatus (SAM85) combining with in-situ X-ray radiation (diffraction and radiography). An energy-dispersive X-ray method was employed using white radiation to collect the cell parameters of the sample and NaCl to determine the density of sample and provide the pressure scale (using the Decker EoS of NaCl). Sample lengths were monitored by the X-radiographic image. The high temperature was generated by the heating element (graphite) in the high pressure cell. A W/Re3%-W/Re5% thermocouple located at the center of furnace and in direct contact with specimen provided the measurement of temperature.

**Results:** Travel times, sample length and cell parameters were collected along multiple heating/cooling cycles up to 10 GPa, 1000 degree C. The measured P and S wave travel times exhibit systematic variation with pressure and temperature. In this study, we also observed the plastic deformation behavior of the (Mg,Fe)O sample at high temperature (Fig.1) from the radiographic images.

**Conclusions:** This study has shown the importance of direct measurement of sample length during the acoustic experiment, especially at high temperature. Using the parameters collected, the elastic properties of (Mg,Fe)O can be determined at mantle conditions. This composition of (Mg,Fe)O, with 17 mol% Fe, would be a probable composition for ferropericlase at the top of the lower mantle. The information will be used to calculate the seismic velocity profile across the 660 km and compare it to the Earth models in order to put better constraints on mantle composition.

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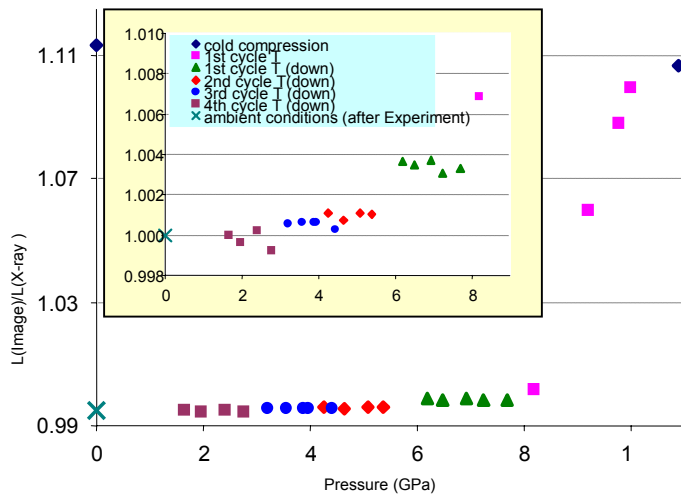


Fig.1 Ratio of sample length from X-radiographic image and calculated from X-ray data. The length data have shown that the sample has been shortened by more than 10% during the first heating cycle due to relaxation. In the later heating cycles, the sample showed some minor plastic deformation.